TRANSMISSION OBJECTIVES

Purpose: The purpose of this addendum is to provide a brief discussion on transmission objectives related to Class 5 digital central offices, and to provide interim recommendations on the design of subscriber loop plant connected to these digital central offices.

Addition:

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FIGURE 1 - SUBSCRIBER LOOP OBJECTIVES

1. GENERAL

1.1 The discussion and interim recommendations in this section are based on the requirements outlined in REA Form 522, General Specification for Digital, "Stored Program Controlled Central Office Equipment". The main purpose of this section is to provide the engineer with interim subscriber loop plant design guidelines.

1.2 The transmission objectives outlined in TE&CM Section 415 dated May 1973 are based entirely on an analog telephone network. Digital carrier systems interfacing with central office equipment and other telephone plant and equipment on a voice frequency basis are considered part of an analog network. Where digital central office and transmission systems interface on a digital basis without decoding, it is considered part of a digital network.

1.3 The AT&T Company has established a transmission lo the telephone network as it evolves from an all a into a mixed analog and digital network. This will be briefly in Paragraph 2.

1.4 By design, the Class 5 digital central office meet the present AT&T analog transmission net as well as those established for the evolving digital calls could exceed present analog loss objectives by Throughout this discussion, the term "loss" refers to near 1000 hertz (i.e., 1004 Hz).

1.5 The emphasis of this discussion is on the Cla office or digital switching office (DSO) in c remote switching terminals (RST), subscriber line con

subscriber carrier (SC) and trunk carrier. The format for the digital network will be compatible with the D3 voice encoding (excluding the signaling bits) and transmitted over digital span line hierarchy such as T1, T1C, T2, etc., as established by the AT&T Company.

2. DIGITAL NETWORK OBJECTIVES

2.1 To provide for an orderly transition into a mixed analog and digital network, the AT&T Company has established transmission objectives for the evolving digital toll and EAS network. The following summarizes the basis for these objectives.

a. Maintain existing maximum toll and EAS loss objectives.

b. Minimize loss contrast between analog and digital paths.

c. Maintain symmetrical loss between Class 5 offices.

d. Maintain compatibility with existing maintenance and administration procedures.

e. Maintain adequate margin for singing, listener echo and talker echo.

2.2 Where the Class 5 DSO is connected to the toll (and EAS) network on an analog basis, existing analog network transmission objectives apply. Where the Class 5 DSO is connected to another Class 5 or higher DSO via a direct digital connection, digital network transmission objectives apply. When digital transmission objectives apply, the loss shall be adjusted to the proper value in the receive side.

2.3 The following Class 5 to Class 5 network transmission loss objectives were established by AT&T in June 1977:

Network Connection	Loss in dB	
	All Digital	Mixed Digital & Analog
Toll	6	6 or 6 + VNL
EAS	3 or 6	3 or 6

2.4 To meet the network transmission objectives, REA has established the following insertion loss values for a Class 5 DSO. (Refer REA Form 522 for details).

.41 Analog Network: The trunk-to-trunk or trunk-to-line DSO loss shall be set between 0 and 0.5dB for 2-wire to 2-wire voice equency connections. The DSO loss shall be set at 0dB for 2-wire to wire or 4-wire to 4-wire voice frequency connections.

.42 Digital Network: On a direct digital interface connection, the loss through the DSO shall be adjusted to the proper value in e receive side.

2.43 Local Calls: The 2-wire line-to-line DSO loss shall be set between 0 and 2.0dB.

2.44 Stability: The long-term allowable variation in loss through the DSO shall be ± 0.5dB from the loss specified by the DSO manufacturer.

2.45 For purposes of assigning transmission loss, remote switching terminals (RST) and subscriber carrier (SC) connected to the DSO on a digital basis are assumed to be a part of the basic DSO.

2.5 Loss for toll and EAS calls through a Class 5 DSO should be equal to or better than the same calls through an analog central office. To maintain standard test procedures, analog test ports must meet the transmission requirements of trunk ports. Trunk circuit and subscriber loop testing can be done on a conventional basis; the milliwatt generator is accessed on a "no loss" basis through the DSO.

2.6 Initially, some subscriber-to-subscriber calls could exceed the present analog objectives by approximately 1.5dB. This is expected to be offset by RST and PCM subscriber carrier systems being placed closer to those subscribers now on long loops. Statistically, this should improve transmission to subscribers served by a DSO. Up to 2dB loss on local calls within the DSO may be necessary for stability. This results in a maximum loss of 18dB between any two subscribers within the DSO. Toll and EAS calls between limiting subscriber loops result in a loss of 19dB or greater. This is because the trunk connection will be 3dB or greater. Thus, local calls will experience less loss than toll and EAS calls. This method of maintaining stability is preferred over the custom assignment of line balance networks by the COE craftsperson.

2.7 Digital technology in central office applications is now in the state of rapid evolution. Specifications, objectives and guidelines are considered interim at this point in time. As the technology matures and stablizes, the specifications and guidelines are expected to reflect the improvements.

3. CLASS 5 DSO LOOP OBJECTIVES

3.1 There are many ways of approaching design recommendations for outside plant beyond the RST, SLC or SC subscriber terminals. The recommendations in this section are based on conventional techniques using nominal 48 volt batteries, 8dB total subscriber loops, external voice frequency repeaters, loop extenders, etc. By using standardized design parameters and hardware, the consulting engineer can compare alternative equipment on an equal basis. Other economical design techniques that accomplish the same end result may be substituted. Examples of alternatives are voice frequency gain (especially automatically controlled gain) and increased battery voltage within the subscriber terminal equipment.

3.2 The key factors in determining the design limits of subscriber loops beyond the RST, SLC or SC are:

a. Digital vs. analog (voice frequency) interface of switching and transmission equipment (separate versus integrated transmission system).

b. Minimum subscriber battery supply voltage (52 Vdc vs. 44 Vdc) and current (20 mA).

3.3 Loops = 8dB: Where the DSO and RST or SC are connected on a digital interface basis, and the minimum battery supply voltage at the RST or SC is maintained at 52 volts, the subscriber loops from the RST or SC are designed for 1700 ohms (outside plant resistance) and 8dB maximum (Figure 1A). In this case, the RST or SC unit function electrically the same as line units within the DSO.

3.4 Loops = 6dB: Where the SLC or SC interface the DSO on an analog basis, they are independent systems. For stability purposes the SLC and SC systems are usually operated at approximately 2dB loss (Figure 1C). Thus, the subscriber loops must be designed for 6dB maximum. SLC and SC systems are not usually equipped with standby generators or other methods of maintaining 52 volts minimum. Thus, the outside plant resistance limit is set at 1300 ohms.

3.41 Where the DSO is connected to the RST or SC on a digital interface basis, but battery supply voltage at the RST or SC is not maintained at 52 volts, the 1300 ohm outside plant resistance limit applies (Figure 1B).

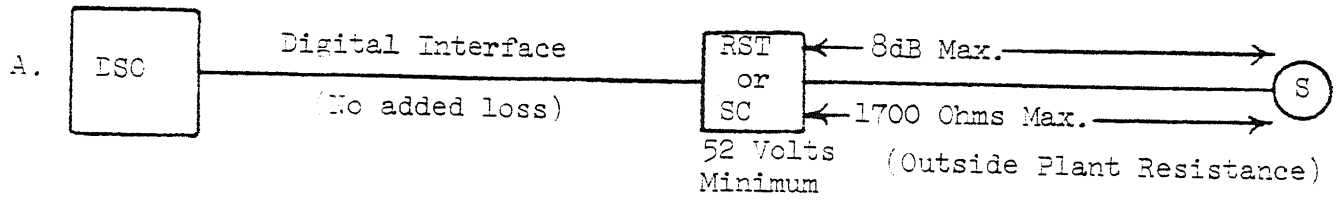
3.42 In some cases, the SLC or SC (separate transmission system) may utilize lower than 2dB loss (i.e., 0dB). If stability can be maintained and other objectives are met (20 mA minimum), the engineer may extend the loops within the transmission objective limits.

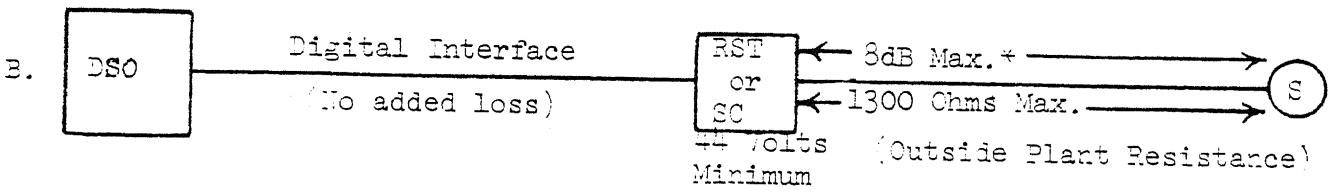
3.5 Loop Treatment: Where the subscriber loops are "treated" with elevated voltage (loop extenders, etc.) and voice frequency amplification (voice frequency repeaters, etc.), decisions are made separately on loop loss and outside plant resistance. The loop current must be maintained at 20 mA or greater under the condition of lowest battery supply voltage. The voice frequency loss must be maintained at 8dB maximum from the analog port where the DSO signals are first decoded (Figure 1D or 1E). Where practical, "loop treatment" substitutes internal to the subscriber terminal may be used to maintain subscriber loop objectives.

Reference

1. W. L. Ross, "Transmission Planning for the Evolving Digital Network", ICC-77, June 1977.

FIGURE 1: SUBSCRIBER LOOP OBJECTIVES





*The 1300 ohm outside plant resistance prevails without loop extenders.

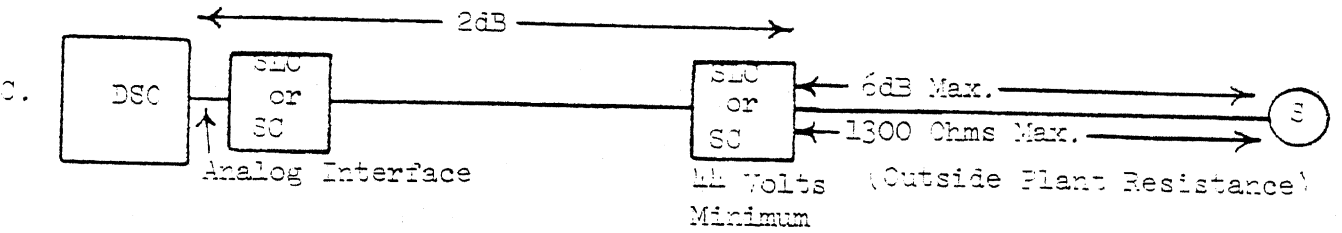
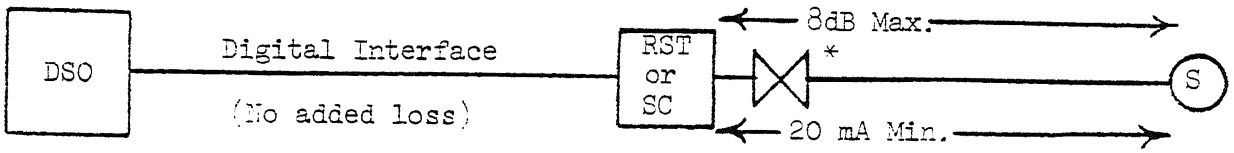


FIGURE 1 - Continued

D.



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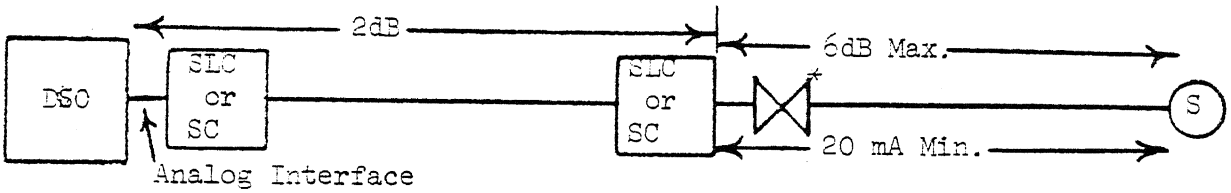

NOTE

*HFR and LE or similar loop treatment. The internal equivalent of loop treatment may be used to extend loops within transmission objective limits.